

## **Spatially mapping thermal conductivity of 2D-materials**

With the downsizing of electrical components to the nanometer scale, one of the major limitations in modern electronics is the dissipation of the produced heat [1]. Understanding the physical processes governing thermal transport at the atomic scale is therefore key for optimizing device performance and reliability. With its superior thermal properties, graphene is an ideal candidate for heat management applications and represents a model system for thermal transport studies [2]. However, the typical methods used to extract the thermal conductivity in bulk materials fail in the case of graphene due to its single-atom thickness. Therefore, in the last decade, methods have been specifically developed for graphene [3]. However, these methods typically assume uniform material properties, and impose restrictions on the employed physical models.

Our lab has recently developed a method that overcomes these limitations, and allows for a full spatial mapping of the thermal conductivity of graphene. Our approach relies on Raman spectroscopy and is applied to suspended graphene membranes in order to reduce the interaction with the substrate. The measured Raman maps are then used as input for a high-performance finite-element model to extract the spatially resolved thermal conductivity.

The aim of this project is to extend this method to other 2D materials and investigate their thermal transport properties at various temperatures (10-500K). The main task of the student will be the Raman characterization of the different materials, together with the extraction of the thermal conductivity using finite-element method calculations. The student will learn:

- Basic sample fabrication
- Raman spectroscopy
- Cryogenics
- Finite-element modelling using Comsol Multiphysics
- High-performance computing

We are looking for highly motivated students with a strong background in nanoscience, physics, or material science. We provide state-of-the-art facilities in a cutting-edge research field.

For more information, please contact Dr. Mickael Perrin (Mickael.Perrin@empa.ch). For applications, please send a short motivation (including educational background and exam grades).